



Lighting For Safety & Security – A Dark Sky Approach

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Introduction

The terms “Dark Skies” and “Dark Sky Friendly Lighting” have, for quite some time, been only associated with the needs of astronomers. The most obvious and simple example of becoming aware of the onset of increased skyglow is in the night sky so the association is understandable. However these terms describe the result of applying good outdoor lighting practice but with some big pluses for the general populace and the night time environment. Whilst this is now being increasingly recognised in some areas of lighting design as well as in the manufacturing sector the need for increased understanding of how to achieve the application of this much needed practice is becoming an important priority.

What is all too often not understood or appreciated is the cause of this undesirable characteristic as well as the benefits of its elimination, or at least its reduction. Unfortunately much current general lighting practice results in increased skyglow coupled with unwanted glare and it's associated disadvantages. Most of this can be remedied by increased care in the selection of luminaires and their application .

The question might be asked what does this dark sky discussion have to do with safety, security and night time crime. What follows is a brief resume of good outdoor practice being actively promoted by the dark sky movement, some associated essential terminology and specific design considerations where security issues are paramount. The latter point includes the necessity of maximising the effectiveness of energy consumed considering the long burning hours generally involved.

It must be stressed that the first principle for successful security lighting must take into account that such lighting will not be effective unless it is integrated into the total security system. The main areas to be discussed are Some Light Technical Parameters, Lighting and Crime, General Design Principles, Light Trespass Concerns, Standards and CPTED Principles.

Some Light Technical Parameters

In the following discussions it will be necessary to refer to some light technical metrics which may not be familiar to many of those involved with the subject of lighting and security. A brief outline of the main lighting units used in the application of lighting techniques will assist in understanding the main issues.

Illuminance values (either in lux or foot candles) form the main and some case the sole measurement unit specified in guidelines, ordinances, etc. It is generally assumed that this relates to the horizontal plane (E_h) and is, unfortunately, often set on the basis “the more the better”. Other types of illuminance measurements which are of vital importance in designing and assessing lighting for security and safety relate to



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those in the vertical plane (Ev) and where CCTV surveillance is carried out illuminance as seen by the camera(s). (Ec) . Effective security lighting design demands results which require the integration of at least two types of these values.

The night time field of view consists of the results from the emissions from luminaires and of the luminaires themselves. The appearance of both is important with sufficient illuminance for the area and its function as well as minimum of glare produced by the luminaires. The latter points out the importance of considering luminaire luminance when determining the overall quality of the installation. Excessive luminaire luminance (glare) causes discomfort and even disability thus contributing to reduced safety and security, This has introduced the unit of luminance which when applied to outdoor lighting is the amount of light reflected or emitted towards an observer. This could be a road or a wall (surface luminance) as well as light coming directly from a luminaire (luminaire luminance). Both forms will affect the observer's vision in some way.

As the principal reason for installing luminaires is to provide adequate illumination / luminance for the application it is essential to understand the directional characteristics of the emitted light. Most luminaire catalogues provide some form of easily understood light distribution information. The use of this is not restricted to professional lighting designers and should be examined by every decision maker when the specification of luminaires is being considered. The unit of luminous intensity in a given direction is the candela (cd) and forms the basis of all lighting calculations.

Lighting and Crime

It is a common myth that lighting alone reduces crime. As stated above lighting must be regarded as but one important element of a total security system. It can be said that "security lighting" provides a sense of security and safety but these two elements, whilst being associated, are quite different in meaning requiring different lighting solutions. Security could be defined as freedom from worry whilst safety is freedom from danger.

Catering for both of these aspects, generally called security lighting, involves an understanding of psychology and perception and as such requires a much higher degree of design criteria than a simple task application approach in order to achieve a satisfactory end result.

The amount of research into crime and lighting is increasing and so is the variance in views of results. In the street lighting area the work of Farrington and Painter is undoubtedly setting new standards in the public lighting sector of research.

Perhaps the most impressive is the study in 1999 in Stoke-on-Trent involving three areas of housing - one experimental having improved lighting , an adjacent area with unchanged lighting and a third which served as a baseline control against which any changes in crime could be monitored. The upgrade was to the requirements of British Standard BS5489 – 3 (not so different from similar categories in AS/NZS1158.3.1 – 1999) replacing lighting which was below the lowest permissible Standard levels. In real terms this meant the lighting values increasing by a factor of at least two but these



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results cannot be considered as over lighting due to the low original results. These trials showed a considerable reduction in theft, vandalism, vehicle crime in both the experimental area and the adjacent area. There was virtually no change in the control area.

This work and other similar practical research projects indicates that good public lighting does have a place in the effective prevention of crime.

General Design Principles

Luminaires Depending on the application effective security lighting will be achieved by a purpose design or a suitable modification to the “normal” layout using the same type(s) of luminaires. In each case care should be exercised in the overall assessment of luminaire performance including avoiding light trespass. It must be more than simply “crunching” numbers to achieve a given set of illuminance values for specific areas. Considerable attention must be paid to the luminance of luminaires along sight lines in the defined areas. Excessive luminance values will cause glare with subsequent reductions of visibility..

All too often luminaire selection is based on one parameter only – appearance. Whilst the physical integration of the luminaire with the character of the area is an important factor some compromise between “ideal aesthetics” and effective required light technical performance may be necessary.

Light Sources In many types of security lighting installations the identification of colour is an important consideration and must be included as part of the decision making process. An accurate and confident description of a suspects clothing colour or that of a vehicle involved in an accident or criminal incident can be the difference between success or failure in apprehending offenders. Whilst an HID source such as Low Pressure Sodium (LPS) may have many advantages from energy consumption and lumen maintenance aspects it has no value where colour identification is concerned. High Pressure Sodium (HPS) allows improved judgement of colour especially at high levels of illuminance but with less confidence than with “white” light sources.

Starting and restrike characteristics of lamps are important factors where motion detectors are used. This limits the choice of basic lamp families to fluorescent and incandescent but with recent increases in effective performance from LEDs these can now be considered as a practical possibility.

Approach to Design The basis for effective security lighting must be carefully planned. The necessary values of both horizontal and vertical illuminance must be assessed as well as the required uniformities, potential glare and its effects plus associated light trespass. However a number of other prime considerations to be taken into account before a luminaire catalogue is opened. Whilst these are only briefly listed each must be examined in relation to the project in mind.

- i. Carefully identify the potential security problems for each area involved in the project.



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- ii. Establish the degree that the integration of lighting is to play in the total security system.
- iii. Establish whether or not the security aspect can be incorporated in the general lighting layout or will require a separate approach.
- iv. If separate approach is required will it be passive (e.g. all night operation) or active i.e. operated by motion switching or similar devices. A combination of both could be useful in creating uncertainty in the mind of an intruder.
- v. Thoroughly investigate potential adjacent areas which could be the subject of
- vi. Obtrusive light emitted onto adjacent properties i.e. light trespass. This includes high luminance (glare) as well as unwanted illuminance – both horizontal and vertical.
- vii. Detail landscaping features and general characteristics which could influence the location of luminaires. In a new installation consider the screening / shadowing effects of mature trees / shrubs. This review should identify possible areas which could cast a deep shadow, creating hiding places for some one with criminal intent.

The next phase in the planning process involves an appraisal of some luminaire characteristics. This requires an appreciation of some important details included in the points mentioned above as well as noting the following comments.

Security lighting is to deter illegal acts by trespassers in creating fear and uncertainty of being detected, recognised and even apprehended. This means effectively illuminating people, objects and places which could be used a location for concealment. This broad range of situations indicates that the selection of luminaires is going to require considerable attention in order to provide adequate illuminance to ensure identification can take place at a sufficient distance to enable defensive action, if necessary, to take place. This characteristic must not produce glare which will interfere with overall vision and should reduce the fear of crime of those lawfully using these areas.

As the possible fields of application will require differing light technical solutions a practical approach is to have a matrix of required design characteristics, a list of possible areas, activities etc and high, medium and low emphasis rating

The required design characteristics could include the following but is by no means a complete list.

- 1 Direct Glare (this could be subdivided for improved performance)
- 2 Light distribution on both horizontal & vertical surfaces (subdivision could help)
- 3 Identification of people (especially faces)
- 4 Attention to shadowing
- 5 Appearance of luminaires



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A list of possible areas, activities etc, could include the following but again this is not a complete list:

- Unoccupied spaces such as storage yards, industrial complexes, etc
- Unoccupied spaces such as laneways etc inside private property
- Parks, gardens & similar public spaces
- Private car parking facilities – commercial and Industrial
- Schools and institutions
- Multi family residential areas
- Hotels & motels
- ATMs

The emphasis or importance rating is as stated above – simply high, medium or low. Possible examples could be as follows:

Unoccupied spaces such as storage yards, industrial complexes etc

(1) High, (2) High, (3) Medium (4) High (5) Low

Parks, gardens & similar public spaces

(1) High, (2) High (3) High (4) High (5) High

Light Trespass Concerns

When assessing the performance of a luminaire for a specific task and the resulting lighting design the necessity of paying close attention to the possibility of light trespass has already been mentioned. However as this subject has been receiving increased attention in recent years it is important to discuss this aspect of lighting which has an overall effect on the general community.

Obtrusive light is not just light trespass onto a neighbouring property which can cause complaints but excessive glare (luminance) can cause discomfort from a considerable distance away from the area under surveillance .This can defeat the purpose for which it was installed as well as generate community ill will. Also care must be taken to assess the ambient light in the general area and design accordingly. A car yard in a major city will obviously require a different design than one in a small rural centre.

Apart from the usually accepted problems caused by glare this parameter can work both for and against a security system Unless carefully sited in conjunction with the CCTV system installer glare from luminaires can interfere with camera operation. It should be noted that off site lighting can also reduce camera effectiveness.

.Floodlighting should be so mounted as to direct light away from guardhouses etc as whilst glare can cause uncertainty in an offender it can also cause visibility problems for security personnel

There is no easily specified set of values for obtrusive light which can be used other than those associated with the CIE (International Commission on Illumination) classification of environmental zones. This subject is dealt with in CIE Publication



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150-2003 “Guide on the Limitation of the Effects of Obtrusive Light From Outdoor Lighting Installations”.

Standards

Most countries have Standards or ordinances, either national, state or local government which must be consulted before an outdoor lighting design is commenced. These might cover more than one parameter and could also require special conditions where an environmental control plan operates. Care should be taken to ascertain that any such documents apply in the territory / area where proposed security lighting is being investigated or designed.

Mention must be made of Australian / New Zealand Standard AS1158 .3.1 – 1999 (Currently under review) which covers Pedestrian Area Lighting and Australian Standard AS4282 – 1997 “Control of the Obtrusive Effects of Outdoor Lighting”. The former takes into account the necessity of nominating Risk of Crime as one of three selection criteria.

CPTED Principles

Obviously lighting is but one subject in CPTED principles. However it is quite an important issue in a well designed security installation, The basic lighting design parameters described above are generally in alignment with CPTED principles however it is strongly suggested that advice be sought from lighting professionals who are experienced this area of outdoor lighting before proceeding with any major installation.

References

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